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FUELED BY: NASCAR KIDS

Part 2: Sound

Why Do NASCAR Drivers Need To React Fast?

Grade Level	Topic	NGSS
3-5	Properties of Materials	LS1.D

Phenomenon

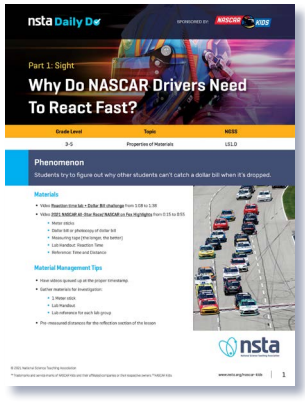
Students try to figure out which reaction time is faster, sight or sound, and how that knowledge will help them catch a falling dollar bill.

Materials

- Video—Reaction time lab + Dollar Bill challenge from 1:08 to 1:38
- Video—NASCAR Racing with Spotter Audio CH9RACING Pro Truck
- Meter sticks (1 per group of 3)
- Dollar bill or photocopy of dollar bill
- Measuring tape (the longer, the better)
- Lab Handout—Reaction Time
- Reference—Time and Distance

Material Management Tips

- Have video queued to play at the right starting times.
- Gather materials for investigation:
  - 1 Meter stick
  - Lab Handout
  - Lab reference for each lab group



Consider using this lesson in tandem with or right after the NASCAR lesson Think Fast: Sight Reaction—Why do NASCAR drivers need to react fast? The lesson can be used without having previously taught that lesson, with some minor modifications that will be noted in the lesson guide.

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SCIENCE AND ENGINEERING PRACTICE(S)	**Develop a diagram to convey a process** Use a model to test relationships or interactions concerning the functioning of a natural system.
DISCIPLINARY CORE IDEAS Targeted Science Ideas and Engineering Ideas (when applicable)	**LS1.D—Information Processing** Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain.
CROSSCUTTING CONCEPTS	**Systems and System Models** In grades 3–5, students understand that a system is a group of related parts that make up a whole and can carry out functions that its individual parts cannot. They can also describe a system in terms of its components and their interactions.

SUPPORTING EQUITABLE PARTICIPATION

Interactions

One-to-one | One-to-small group | One-to-many | Small group-to-many

Modalities

How students communicate their ideas

Talk • Text • Visual: Drawing, Symbols, Table, Graph, Chart, and Gesture

Safety

NSTA encourages K–12 teachers and school leaders to promote and support the use of science activities in science instruction and work to avoid and reduce injury. Additionally, NSTA recommends teachers and school leaders visit the NSTA Safety Resource page for up-to-date information on safety issues and guidelines.

EXPERIENCE PHENOMENON

Students experience the phenomenon or problem. The teacher creates an **opportunity for students to connect** with this specific event or problem (through prior experience, interests, and curiosities) and **raise or identify a student question** to investigate.

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What is the teacher doing to support students' sensemaking?	**What are students doing to make sense of the phenomenon? (Includes teacher look-fors)**

1. Introduce the Phenomenon

Gather students and introduce NASCAR racing to students to elicit excitement and experience the phenomenon together.

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Tell the students you have an interesting video clip you would like to share with them. Explain that the clip is of a NASCAR truck series race, and you want their help in figuring out why someone would be talking to the driver. Show the first 2 minutes of the video **NASCAR Racing with Spotter Audio CH9RACING Pro Truck**	Students watch the video to figure out the phenomena.
Ask students to write down things they hear being said to the driver (play the clip again if necessary). Tell students they do not need to write down everything word for word, just a general summary. Next, use the probing questions to prompt students to think about what they heard. • What type of information is being relayed to the driver? • Why does the driver need that information? • What does the driver do with the information? • How could it influence the decisions the driver is making while racing? • Does the auditory information help their reaction time?	Students record what they hear the driver saying. Students are prompted to think about why a driver might need someone to talk to them during a race.
Have students discuss the probing questions in small groups, then share their ideas with the whole class. Also, explain that the person they hear talking is called a spotter. A spotter is a person who sits where they can see the whole track (usually up high) and helps the driver by telling them about things they can't see. Then say, "It really seems like the driver is getting a lot of information from their Spotter. I wonder if they rely more on sight or the sound (words) the spotter shares?"	Students discuss their ideas about the information the driver is getting, then go public with their thinking.
Poll the students to see if they think we rely on more on sight or sound. Record the poll results on the board.	
Next, take a poll about sight versus sound. Ask students if they think they would react better to sight or sound and record the results in a public space.	Students take a poll to give their opinion about whether they think they have better reaction time to sight or sound.

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Then show students the following video clip, Reaction time lab + Dollar Bill challenge, from 1:08 to 1:38, of students trying to catch a dollar. (If students have done the lesson Think Fast: Sight Reactions, you can skip showing the video and instead have a short discussion to reorient students to what they figured out about sight reactions.)	Students watch a video about sight reactions or participate in a review discussion about the sight reaction lesson.
After watching the video or reorienting students with the sight reaction lesson, present a second poll to your students asking that if the kids in the video closed their eyes and the teacher gave them an auditory clue, would they catch the dollar bill more often? For example, if the teacher said "catch" or "now" just as he dropped the dollar, would they have a better chance at catching the dollar? Record the poll results on the board or common space.	Students think about sight versus sound and if a sound or word might help the students in catching the dollar bill. Students take another poll to give their opinion.
Explain to the students that both of the videos demonstrate **reaction time**. If you have a word wall in your classroom, consider adding this word to it using your students' ideas for a definition.	Students develop a definition of reaction time.
Once students have come up with a definition, say, "Reaction time is how fast we do something in response to something else." For example, ask students what they do when they have touched something that is hot. Tell them, "Today, we are going to focus on how fast we can react to sound." *Note—If students have already done the Think Fast: Sight Reactions lesson, tell them that when they have completed today's investigation, they will compare their sight reaction times to their sound reaction times. Another option would be to do both a sight and a sound reaction time investigation during this lesson.*	

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In their science notebooks (or on a piece of paper if not using science notebooks), ask students to divide one page in half and title one half "Sight—No Sound" and the other half "Sound— No Sight." Ask students to develop a model that could explain the process that happens in the body that would allow someone to catch a dollar bill when it was dropped, like in the video. Explain that their models should include both components (the parts in the system) and the relationship among the components (how the parts interact with one another). Remind students that they can represent things they can't see, such as light or sound, and to describe processes they can't see, such as things happening in their bodies like muscles working. Some expected ideas students might include are these:

- Our eyes have to see it, or our ears hear the signal.
- Our hands have to move to catch it.
- Our brain has to tell our hands what to do.
- There is a process that starts with the eyes or ears sending information to the brain and from the brain to our arm and hand.

As students develop their models, encourage them to use words, symbols, pictures, or anything they think helps explain what's happening. Ideas for things they can't see but want to describe are fine (for example, nerve impulses to the brain).

The goal here is to get students thinking about how their sense organs and body systems need to work together. They do not need to have everything correct in their models at this point. This can also be used as a formative assessment opportunity to assess prior learning and background knowledge.

Note—If students have done the Think Fast: Sight Reaction lesson, they could add to the model they developed during that lesson.

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Students develop an initial model to explain how their bodies might work to catch the dollar bill in different situations.

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Give students a couple of minutes to compare their model with an elbow partner. Ask them to mark places where they had the same idea as their partner with a checkmark and any unique ideas (ideas found on only one person's model) with a star. As students share with each other, move about the room and look for common ideas and ideas that are unique. Again, ask a few kids to be ready to share their ideas with the whole class.	Students work with a partner to compare ideas and look for similarities and differences in their models.
As a whole class, guide a discussion of their ideas. While they share, create a whole-class consensus model highlighting the big ideas. Take time to focus on what they think is different in the process when they use sight or sound. Expect some agreement and/or disagreement on what's important. Look for things students might omit from their explanations, like light moving from the dollar to the eye or sound moving from a person (or other source) to their ear. The goal is not to get the process correct, but to explicitly have all student ideas gathered in one place for the class to see.	The whole class works together to make a model that contains ideas and questions about the lesson question: **Does using sight or sound make it easier to catch a dollar bill?**

Use discussion prompts, listed below, to support students' ideas around system and system models.
• We have different components (parts) in our model, but what else do we need to add to our model?
  ◦ Leads to needing to include how the components of the system work together
• What do you think might happen if a part of the system model changed? For example, what if the person had to wear a blindfold?
  ◦ Leads to the idea that body systems work together
• Thinking about body systems, what evidence do we have that supports the idea that systems work together?
	Students are prompted to think deeper about the body systems and processes needed to explain the phenomenon.

Last, ask students how they could investigate this challenge to figure out more. Many students will say they should try the dollar challenge or engage in some kind of investigation about reaction time using an auditory queue. Agree with this idea, and transition into the investigation	Students share investigation ideas that lead to next steps.

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INVESTIGATE

Students engage in the practices of scientists and engineers to build understanding of targeted science ideas (and engineering ideas) needed to explain the phenomenon or solve the problem.

Prepare for the investigation.

Students prepare to test both sight and sound reaction times.

Show students a meter stick, yardstick, or other ruler. Solicit a volunteer to help demonstrate how to measure reaction time by dropping the ruler and seeing how far the ruler has moved by the time it is caught. If your rulers have both metric and customary measurements, decide as a class which you will use before they begin. This is important for having results you can compare. Some students may need guidance in reading a ruler. Note that additional guidance about how to calculate an average may also be necessary. (Calculating average is a skill introduced in fifth grade. If you are working with younger students, consider modifying the investigation by having them circle the measurement that falls in the middle.)

Distribute the lab handout with data table. Before beginning the activity, have students revisit their models of how the body reacts with a sight-based stimulus vs. a sound-based stimulus.

Do the Investigation · Part 1

Students get ready for the investigation.

(If students did the NASCAR Reaction Time—Sight lesson, they can choose to copy over that data or redo the experiment in full.) In groups of 2 or 3 students, conduct the investigation with their eyes open and no audio cues. They use the table provided or the online calculator to determine their reaction times.

Before they begin, take a few minutes to orient the students to the lab handout. Ask students why it might be important to repeat the experiment several times and take an average of their results. Expect responses like these:

- We might mess up the first time.
- We might get better over time.
- We could be really fast one time and really slow another time.
- To know if our results are accurate

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Do the Investigation · Part 2 In the same groups of 2 or 3 students, conduct the investigation a second time, but this time with their eyes closed. The person dropping the ruler should give an audio signal at the exact moment they drop the ruler. Encourage students to practice once or twice before they begin their data collection.	Students investigate their sound reaction time.
Do the Investigation · Part 3 (Optional) Some students may wonder if combining the two modes would improve their reaction times. If you have the time, consider allowing them to conduct the experiment a third time, combining sight with the audio cues.	

REFLECT

Students use the new or revised science ideas they developed to help explain how or why the phenomenon occurs and/or to identify solutions to the problem.

Making sense of the investigation. In groups of 3–4, ask students to share their data or averages for each part of the experiment. Look for patterns in the data. Was the sight reaction time or the sound reaction time faster? The anticipated result is that the reaction time for sound should be faster than that for sight in most instances, which is likely to be counterintuitive to students but is supported by research.	Students compare data from their experiments to draw conclusions.
Reconnect to the NASCAR videos. Share with students that each NASCAR driver has many people who help them during a race. A NASCAR team is composed of as many as 10–15 members who work together to help the driver get around the track quickly and safely. They include the Team Owner, Team Manager, Crew Chief, Specialists, Engineers, Mechanics, Pit Crew, Driver, and Spotter. The Spotter was the person heard in the racing video.	Students begin to consider how a team supporting a driver could affect a driver's reactions by changing a part of the system model.

T	S
Reconnect to the NASCAR videos. Share with students that each NASCAR driver has many people who help them during a race. A NASCAR team is composed of as many as 10–15 members who work together to help the driver get around the track quickly and safely. They include the Team Owner, Team Manager, Crew Chief, Specialists, Engineers, Mechanics, Pit Crew, Driver, and Spotter. The Spotter was the person heard in the racing video.	Students begin to consider how a team supporting a driver could affect a driver's reactions by changing a part of the system model.
Revisit the class model. Ask your students to look at their initial model in their science notebook. Give them a couple of minutes to try to identify (circle) places in the system of sight reactions and sound reactions that might explain why reaction times from sound-related stimuli are faster than those from sight-related stimuli. Also, ask them if there is anything they would like to add to the class model.	Revisiting and/or revising a class model is a core tenet of science. Models are constantly revised in science when new evidence comes to light. In this discussion, the class still won't know what contributes to the improved reaction time, so the purpose of this discussion is to solicit initial ideas and possibly new ideas for investigation. As students respond, use some probing questions to motivate reasoning and class discussion. Some suggestions include these: • Does everyone agree? • Who had the same idea as…? • Why did you think ___ was important? • How might that work?
Focus on the Spotter. With the model revision, ask students about how the Spotter, sitting above the track and watching all of the cars in the race, helps the driver's reaction time. What changes in the model when someone is telling you in advance what is about to happen or informing you about things you can't see or hear? How might a spotter warn you of a crash or obstacle you didn't know about? What role does the spotter play in keeping the driver safe? Expected responses include these: • The Spotter warns the driver. • The Spotter sees things the driver doesn't. • The Spotter can tell the driver what to do or avoid. • The Spotter lets the driver anticipate instead of react. • The Spotter helps the driver be ready for what is coming, especially when they can't see it. • The Spotter can yell at the driver to get a quicker reaction time (sound).	

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Consider having your students read this article— https://ftw.usatoday.com/2020/02/nascar-daytona-500-spotters-kyle-busch-joey-logano—or project the first picture in the article for them to see.

Optional

Ask students to add a page in their notebooks and title it Reaction Time. Create a three-column chart under the title with the following headings:

Situations that need fast reaction time	Factors that affect reaction time	People who have (or might need) fast reaction time

Provide some time for students to add their ideas to the chart. Invite a few students to share some of their ideas with the class. If students don't include driving a car as a situation needing fast reaction time, suggest it now. Ask what kind of things drivers need to watch for and what tools are in cars now to help drivers keep track of the road around them. This step is important for your students to build a deeper connection to the phenomena. Encourage them to think of situations when they needed fast reaction time, and to expand their thinking to the world around them by also thinking about other people who might need fast reaction times.

The dropper would warn the catcher they were going to drop the ruler by saying "1,2,3, Drop." Of course with the brain activated and ready, reaction time for everyone should improve dramatically.

This lesson could be one in a series of lessons building toward the following:

4-LS1-2—Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

[Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

AT THE RACE TRACK

Find the spotters and the spotter platform!

Look for the spotters' tools, including radios, headsets, and binoculars. Imagine how a spotter sees the track. Draw a picture of the track from your view and one from the Spotter's view. How would your pictures look different? If possible, at the track you are visiting, consider taking a track tour.